EM375 Project Handout
CALCULATING THE LAUNCHER EFFICIENCY

THEORY: The testing of the elastic properties of the tubing made it possible to calculate the potential energy stored in the rubber bands. This energy is transferred into the kinetic energy of the moving masses. In addition, some energy is dissipated. Where and why? When you use the full size launcher, you need to know how much of the original potential energy is transferred into kinetic energy. We call this ratio the efficiency of the launcher. We will use the results from the model launcher to estimate the efficiency, and assume that both launchers are similar.

Calculate the strain potential energy in the tubing from its extension using the methods in the "Launch Speed vs. Stretch Ratio" handout and the elastomer properties you determined in the "Rubbers Lab."

The kinetic energy is determined from the launch speed of the ball and the various masses. We do not know the actual launch speed, so you will "back calculate" it from the measured impact distance using the MathCAD worksheet developed in the "Simulation of Projectile Motion" handout.

What value of efficiency would seem realistic? Where does the 'missing' energy go? Is it reasonable to assume that the full-scale launcher has a similar efficiency to the model launcher? What could it mean if you get an efficiency greater than 100%?

PROCEDURE:
Obtain the following data for the full-scale and model launchers:

	Full-scale	Model
Tubing unstretched length, L_O (in)		
Pouch diameter, D_C (in)		
Cross sectional area of one tube, A_O (in^2)		
Mass of pouch, m_C (slugs)		
Mass of tubing between frame and pouch, m_T (slugs)		
Height of center of launcher frame, H (in)		

DATA REDUCTION: Use the blank table below to record your values and results for each stretch ratio and launch angle for the model launcher.

Columns (1), (2) and (4): Complete these columns from the data obtained in the "Measurements Lab"

Column (3): Calculate these values from the data in Column (2) and the constants found during the "Rubbers Lab". Use the strain hardening relationship.

Column (5): Use your Mathcad projectile motion worksheet and the parameters for the small balls to calculate the launch speed from the data in columns (1) and (4).

Column (6): Use the "Total Kinetic Energy" equation in the "Launch Speed vs. Stretch Ratio" handout to calculate the total kinetic energy at launch from the data in Column (5).

Column (7): Calculate the launcher efficiency as the ratio of kinetic energy to potential energy, (Column 6) / (Column 3).

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Launch Angle	Stretch Ratio	Energy in Tubing	Impact distance	Launch Speed	Kinetic Energy at Launch	Efficiency

How do you determine the single final efficiency value to use in later calculations?